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Making exit costly but efficient: the political economy of exit clauses and secession

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Abstract

This article presents a political economic analysis of exit from federations. Over time, members' benefits from being in a federation can fluctuate because of changes in the state of the world. If a member stops benefitting, it may wish to secede i.e. exit the federation. Based on a real options model, we show that state-contingent exit penalties can induce socially efficient exit decisions. In addition to the substantive implications, this represents a methodological contribution to real options theory. Even if ex-ante specified exit penalties cannot be made state-contingent, they may still enhance social welfare by preventing secession wars. This finding runs counter to the dominant view in the literature that exit clauses should be avoided in federations. As a first test of the model, we derive five hypotheses and show that they hold for the breakup of Yugoslavia and all cases known to us of federations with an exit clause.

Keywords: Exit Clauses, Secession, Federalism, Real Options

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This article develops a political economic model of secession and the potential role of exit clauses. Generally speaking, an exit clause specifies the conditions of exit or withdrawal from an agreement. Examples of exit clause conditions are the payment of a penalty or waiting out a notice period. In most types of international treaties, safeguard clauses regulating temporary escape or withdrawal clauses regulating permanent exit are relatively prevalent (Koremenos and Nau 2010; Rosendorff and Milner 2001). As an alternative way of ensuring flexibility, international agreements may be concluded for a limited duration (Koremenos 2005). This is not the case for federations, which almost by definition have indefinite durations and in which exit clauses regulating secession are relatively rare. To the best of our knowledge, the only current examples are the secession clauses in the 1991 constitution of Ethiopia (Habtu 2005) and the 1983 constitution of Saint Kitts and Nevis (Weinstock 2001).[3] The European Union (EU), which has many characteristics of a federation, also has a withdrawal clause (Athanassiou 2009).[4] A historical example is Article 72 in the constitution of the Soviet Union (Sunstein, 1991: 645-647): "Each Union Republic shall retain the right freely to secede from the USSR".

Depending on how a secession takes place, it can be peaceful and swift, or painful and costly (Tir et al. 1998; Young 1994). If there is no exit clause in the federal constitution, exit from a federation requires an ex-post negotiated solution, i.e. consent from the remaining members. If a negotiated exit cannot be reached, embarking on a destructive secession war may be the only alternative for a member wishing to secede (Helfer 2005). We analyze three modes of exit: exit based on an exit clause, unilateral exit through a secession war, and negotiated exit. Considering

[3] The conditions in the Federal Republic Ethiopia include a two-thirds majority in the Parliament of the seceding region. Saint Kitts and Nevis allows for secession by Nevis in case a two-thirds majority is reached in an independence referendum in Nevis.

[4] Article 50 of the Treaty on European Union specifies that any Member State may withdraw from the Union by notifying the Council, and is guaranteed the right to leave unilaterally within two years.

the Soviet case, we allow for the possibility that the federation meets the triggering of an exit clause with an anti-secession war. Based on a real options model, we show that state-contingent exit penalties can induce socially efficient exit decisions even if there are barriers to ex-post negotiation. In addition to the substantive implications, this is a methodological contribution to real options theory.

This paper is structured as follows. First we introduce the notion of efficient breach and review the literature on exit clauses. Then we introduce our model, of which we formally solve a decision theoretical version. Based on the insights from this analysis, we discuss the game-theoretical aspects of exit. Because a formal game-theoretical model incorporating barriers to negotiated exit would not be tractable, we offer a discussion instead. We demonstrate the plausibility of our conclusions by showing how the dynamics of the breakup of Yugoslavia can be explained based on our theory, and review all cases known to us of exit clauses in federations. While the evidence is supportive of the predictions of our model, it is by nature inconclusive in any statistical sense due to the small number of cases. In the conclusion, we identify three tentative reasons why exit clauses are actually rare in federations, in spite of their potential benefits.

Efficient breach and the literature on exit clauses

The idea that not respecting a contract may be socially desirable is known as *efficient breach* (Goetz and Scott 1977). In theory, if exit is efficient those better off outside could offer an acceptable side-payment for exit and make everyone better off – an application of Coase (1960). In this light, Drèze, De Grauwe, & Edwards (1993) discuss a practical rule suggested by Drèze to ex-post reapportion national debt at the time of secession. However, as pointed out by De Grauwe, ex-post renegotiation may be very difficult politically. Hence ex-ante negotiated exit clauses may be necessary to enable efficient breach.

In spite of the potential benefits of secession clauses, the dominant position in the constitutionalist literature is that they should be avoided. This position was pioneered by Sunstein (1991), who sees constitutions as pre-commitment strategies in the presence of multiple equilibria. Chen & Ordeshook (1994) take the same starting point, but develop a formal three-player game-theoretical model which is taken up further in Filippov, Ordeshook, & Shvetsova (2004). Their conclusion is that there should be a constitutional ban on exit, in order to coordinate on non-secession equilibria, which are assumed to be Pareto superior.

The strength of the conclusions drawn by Chen & Ordeshook (1994) is limited because of three strong assumptions. First, they assume that maintaining the federation is always socially efficient (efficient breach does not exist by assumption). Second, they assume that without an exit clause, exit cannot occur. In reality a party wishing to exit may embark on a destructive secession war. Third, they assume that exit clauses are necessarily unconditional, i.e. free in use. In reality, exit will necessarily cause one-off transaction costs, and exit clauses could conceivably stipulate a penalty to be paid to the remainder of the federation.

Bordignon & Brusco (2001) analyze optimal secession rules in a two-player game with two periods and a discrete stochastic state. In period two, members of the federation decide between accepting a federal allocation or starting a secession war. The conclusion is that secession clauses may be inefficient if the benefits from the federation depend significantly on its perceived stability. While this model allows for stochastic shocks and hence the possibility of efficient breach, it still has some important limitations. The discretized set-up with only two periods and four states of the world precludes the analysis of optimal exit timing. In addition, they introduce a new restrictive assumption compared to Chen & Ordeshook (1994), namely that countries are ex-ante identical.

Using a formal model of costly exit clauses, we show that the position of Sunstein (1991) and Chen & Ordeshook (1994) against exit clauses is tenuous. By modeling the dynamic aspect of exit decisions in continuous time, we introduce considerations of optimal exit timing absent in Bordignon & Brusco (2001). In addition, our model allows for members of the union to be different ex-ante, so that the distributional consequences of exit clauses can be studied. We also show that appropriately costly exit clauses do not increase the likelihood of exit given the implicit option of unilateral exit through a secession war.

The model

The following continuous time model describes a political union between two federated entities or members indexed by $i \in \{A, B\}$.[5] For tractability, we assume that the entities of the federation are composed of identical inhabitants, and leave the incorporation of within-entity heterogeneity for future work. This means that each federal entity can be modeled as a unitary actor. For each such entity or member of the federation i, the net benefits of being in the federation versus outside depend on the rules of the federation and a member's characteristics. Consistent with the literature on the size of nations, we assume that the benefits and costs from being part of a federation comprise economies of scale in the provision of public goods, the internalization of externalities, fiscal transfers, and welfare losses from centralized decision-making in the presence of heterogeneity between the federated entities (Alesina and Spolaore 2003; Desmet et al. 2011; Hug 2005). Each of these components is determined by the substantive terms of the federation, such as the rules for computing fiscal transfers, and the characteristics of the entities, such as their average income. We denote an entity's net benefits at the time of the creation of the federation by its type, θ_i. A high type indicates high benefits from the union. Forcefully incorporated members of the federation may have a negative type.

[5] For a discussion of the importance of administrative divisions of states, see Griffiths (2015).

Over time a member's benefits from being in the federation versus outside may change because of changes in the state of the world. For instance, a member may become richer. While this may be good for the member per se, it may also decrease its benefits from the federation, because it will have to pay higher fiscal transfers. This may be the case for Catalonia in Spain and Flanders in Belgium. As another example, consider changes in heterogeneity: over time, the culture and preferences of people across the federated entities may converge (diverge) such that the benefits of the federation for each federated entity increase (decrease). As a third example, two key external parameters can decrease the benefits from economies of scale: free trade and peace (Alesina and Spolaore 2003). With more free trade outside of the union the economies of scale from having a large internal market become less important. Likewise, the lower external military threats, the less important the economies of scale in the provision of national defense. Finally, consider changes in the attractiveness of the outside option, such as through the emergence of a free trade bloc like the European Union.

In our model, we capture all changes in the state of the world that are relevant for a member's benefits of being in the federation versus outside by its state x_i. A high state means that a member is currently enjoying the federation more than when it was created, and vice versa. We assume that the link between the state of the world and benefit flows is exogenous. Substantively, this assumption means that the terms of the union cannot be renegotiated, e.g. the rules for computing fiscal transfers cannot be changed. While this is a limitation, we leave for future work a model where the link between the state of the world and benefits is endogenous.

To summarize, the net benefits for both members from being in the union versus outside depend on the stochastic state of the world at time t, $x(t) = \left(x_A(t), x_B(t)\right)$, and on the members' types (θ_A, θ_B). Concretely, member i's net benefit flow $\pi_i(t)$ at time t is given by:

$$\pi_i(t) = x_i(t) + \theta_i \tag{1}$$

The state of the world captures the changes in benefits over time, which are uncertain. For simplicity, assume that member i's state $x_i(t)$ evolves according to a Brownian motion without drift and with variance σ_i^2. A Brownian motion is a mathematical representation of a random process over time. Over any given time period dt, it can go up or down. The increments dx_i have a normal distribution characterized by variance σ_i^2 (Mörters and Peres 2010). A higher variance σ_i^2 means that member i's benefits are expected to fluctuate more. Formally, a Brownian motion is characterized by

$$dx_i = \sigma_i \epsilon_{it} \sqrt{dt} \tag{2}$$

where ϵ_{it} has a standard normal distribution and is serially uncorrelated so that for all $t > 0$

$$E[\epsilon_{it}] = 0, \qquad Var(\epsilon_{it}) = E[\epsilon_{it}^2] = 1, \qquad E\left[\epsilon_{it_1}\epsilon_{it_2}\right] = 0, t_1 \neq t_2 \tag{3}$$

This implies that $E[dx_i] = 0$ and $E[(dx_i)^2] = \sigma_i^2 dt$: benefits are expected to remain the same, but have a variance of σ_i^2 per unit of time.

Assume furthermore that the increments ϵ_{At} and ϵ_{Bt} of the Brownian motions $x_A(t)$ and $x_B(t)$ are jointly normally distributed for all t, with correlation ρ so that

$$E[\epsilon_{At}\epsilon_{Bt}] = \rho, \; E[dx_A dx_B] = \rho\sigma_A\sigma_B dt \tag{4}$$

A positive correlation means that both members' benefits tend to move together. A negative correlation means that changes in the state of the world tend to have an opposite effect on both members.

Without loss of generality, suppose that the union starts at $t = 0$ and set $x_i(0) = 0$. Since we have assumed no drift in the states x_i, their ex ante expected value is 0 for any future date T; mathematically, $E[x_i(T)] = 0, \forall T > 0$. Similarly, the expected value at time t for a later time T is simply the value at the time of the expectation: $E_t[x_i(T)] = x_i(t)$. At time t the probability density for time T at state x_i is

$$P_t(x_i(T) = x_i) = \phi(x_i; x_i(t), \sigma_i^2(T-t)) = \phi\left(\frac{x_i - x_i(t)}{\sigma_i\sqrt{T-t}}\right) \tag{5}$$

where $\phi(x; \mu, \sigma^2)$ is the probability density function (pdf) of the normal distribution with mean μ and variance σ^2, and $\phi(x)$ is the pdf of the standard normal distribution. Substantively, this means that the expected change in x_i over any time period $T - t$ is zero and that large changes are less likely than small changes. However, since the variance increases linearly with the time period $T - t$ the expected magnitude of changes increases with time.

Assume that the members have a common discount rate r, so that the expected discounted benefit from the union for member i until time T is $E\left[\int_0^T \pi_i(t)e^{-rt}dt\right]$. The ex-ante expected value for member i from a perpetual union is

$$E\left[\int_0^{+\infty} \pi_i(t)e^{-rt}dt\right] = \lim_{T\to+\infty}\left(\frac{\theta_i}{r} - \frac{\theta_i}{r}e^{-rT}\right) = \frac{\theta_i}{r} \tag{6}$$

Hence, member i only voluntarily enters the union if its type $\theta_i > 0$. Members with $\theta_i < 0$ may be coerced to join the union, but clearly such members want to secede from the federation if the exit costs are not prohibitive. Even if the union is ex ante beneficial for all, in some states of the world $x(t)$ it may turn out so bad for one or both members that they may wish to exit.

In the model, we consider two types of ex-ante fixed exit conditions: penalties and one-off costs. An exit penalty consists of the payment of an amount c_i by the exiting party i to the remaining party j. All other costs associated with exit are grouped in the one-off costs k_i. This parameter comprises all non-transfer costs required explicitly or implicitly by the exit clause, such as the costs of organizing a referendum (if required), and the legal costs of creating a new state. The costs c_i

and k_i have the same effect on party i, but only c_i will be received by j as a compensation for exit. While k_i is partly endogenous, c_i can be freely specified.

As an example, consider the EU's Article 50. This clause does not specify a penalty, although it does stipulate a waiting period of two years. An example of a penalty that could have been included would be the payment of an additional year's budget contribution. The clause does not specify one-off costs such as the organization of a referendum, but clearly exit from the EU requires a substantial amount of legal costs. As an important side note, by triggering Article 50 a Member State can only guarantee full departure from the EU. This means losing all of the associated benefits, such a access to the Single Market, and all of the costs, such as the budget contribution. The leaving state may attempt to negotiate more favorable terms with the rest of the EU, but such negotiations are legally distinct from the exit.

Optimal exit in a decision theoretical setting

To analyze the consequences of exit clauses, this section formally solves a decision-theoretical version of the model, in which only one member can exit. We start below by situating our model in real options theory. Following this, the first subsection discusses optimal exit with a fixed penalty c, assuming that any clause is fully binding. In the second subsection the possibility of a secession war is incorporated. The next three subsections address the uncertainty of exit costs, the consequences of exit for the rest of the union, and the possibility of an anti-secession war initiated by the rump of the federation. The sixth subsection derives conditions for socially efficient exit, and the seventh and final subsection shows that state-contingent exit penalties can induce socially efficient exit.

In the model, we treat exit clauses as so-called *real options*. The theory of options was initially developed to study financial instruments such as put options, which give the holder a right to sell a stock at a pre-determined price in the future. Once developed, this theory has also been leveraged to study other optional decisions, such as the option to acquire a Joint Venture (Kogut 1991). Such applications of options theory outside of financial applications are called *real options theory*. The main technique used is dynamic stochastic programming, which requires the use of stochastic differential equations (Øksendal 1991; Stokey 2008). Our model builds on Dixit (1989) and Dixit & Pindyck (1994), who study firms' decisions to enter and exit markets with changing output prices. Since output prices are normally positive, they focus on geometric Brownian motions. In contrast, the model presented here assumes a standard Brownian motion because the benefits from a federation can become negative.

Our methodological contribution to real options theory is twofold. First, we extend the basic model of exit by a firm from a market to exit by a member from a federation. Unlike in a market, exit by one member of a federation implies a loss of benefits for the other members. Second, we formalize the mathematics of state-contingent exit penalties which depend on the state of the other member in a union. Jointly, these two methodological contributions allow us to derive conditions for socially efficient exit from a federation.

In what follows, we assume for simplicity that exit is definitive and that there is no possibility of re-entering later. However, even if re-entry is free the qualitative conclusions from our model would still hold, but the solution process would be complicated as the optimal exit decisions and optimal entry decisions would be mutually interdependent.

In the decision-theoretical version of the model, we assume that only one member can exit from the union, and only consider that member. Hence for now we drop the index i to lighten notation. When thinking about exit in a continuous time set-up, a member compares the expected value of maintaining the union to the value of exiting right now. Assuming rationality, the expected value of maintaining the union right now should take as a given optimal exit behavior in the future. This is captured by the notion of continuation value: the continuation value $V(x)$ is the expected discounted benefit from maintaining the union when the current state is x, assuming optimal exit behavior in the future (Dixit and Pindyck 1994).

We show in the Appendix that the continuation value is composed of two parts: the expected perpetuity value from maintaining the union, plus the option value of being able to terminate the union. At state x, the benefit flow is $x + \theta$. Since on average the future value of a Brownian motion is equal to the current value, the expected perpetuity value at state x is $\frac{x+\theta}{r}$. The more important the future, the lower the discount rate r and the higher the perpetuity value. As we show in the Appendix, the option value of terminating the union depends on the exit terms. Specifically, the option value is $Be^{\beta x}$, with $\beta = -\sqrt{\frac{2r}{\sigma^2}}$ and B a constant to be determined. Combining the expected perpetuity value and the option value, the continuation value can be written as

$$V(x) = \frac{x + \theta}{r} + Be^{\beta x}\,, \qquad \beta = -\sqrt{\frac{2r}{\sigma^2}} \tag{7}$$

Optimal exit with an exit penalty c

The continuation value is the value of maintaining the union for now, assuming optimal behavior for the future. Hence the constant B depends on the optimal exit state x^e. In the Appendix, we show that when facing an exit penalty c, the optimal exit state and the corresponding value for B are

$$x^e = -\theta - r(k + c) + \frac{1}{\beta}, \qquad B = -\frac{e^{-\beta x^e}}{r\beta} \tag{8}$$

The optimal exit state consists of three components. The first one, $-\theta$, is the most intuitive. When x reaches $-\theta$, the benefit flow drops to zero: $\pi(t|x(t) = -\theta) = -\theta + \theta = 0$. The higher a member's type θ, the longer it is optimal to stay in the union, i.e. the more negative the optimal exit state.: $\frac{\partial x^e}{\partial \theta} < 0$. The second term, $-r(k+c)$, reflects the deterring effect of exit costs since $\frac{\partial x^e}{\partial k} = \frac{\partial x^e}{\partial c} < 0$. The benefit flow needs to drop to $-r(k+c)$ to make exit worth considering, since the corresponding expected perpetuity value at that state would be equal to minus the exit costs $-(k+c)$.

The third term, $1/\beta$, is the least intuitive but can be interpreted as the optimal forbearance level. It reflects sophisticated rational behavior: given that re-entry is precluded, one should be willing to sustain some losses in the hope that the state improves again.[6] Intuitively, the higher the variance of the benefits, the higher the possibility that a bad state turns around, and the more reluctant one should be to exit. This intuition is confirmed: since $\frac{1}{\beta} = -\sqrt{\frac{\sigma^2}{2r}}$, it is easy to show that $\frac{\partial x^e}{\partial \sigma} < 0$.

Given (7) and (8), the continuation value at state x is

$$V(x) = \frac{x+\theta}{r} - \frac{e^{\beta(x-x^e)}}{r\beta} \tag{9}$$

As the state deteriorates to the optimal exit state, the continuation value converges to the cost of exit: $\lim_{x \to x^e} V(x) = -(k+c)$. The higher the cost of exit, the lower the value of the exit option and hence the continuation value: $\frac{\partial V}{\partial k} = \frac{\partial V}{\partial c} < 0$. Members prefer for themselves an exit penalty of $c = 0$.

In summary, optimal exit decisions take into account the exit penalty c. The higher the penalty, the lower the optimal exit state. This is intuitive: the costlier exit, the worse things need to be before exit becomes an optimal decision.

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[6] In fact, even if re-entry is free one should be willing to sustain some losses before exiting (Dixit 1989).

Enforcement problems: the possibility of a secession war

Up to now, we have assumed that any exit clause was fully binding. A member could only exit by paying the ex-ante agreed exit penalty c. However, given that federal constitutions are not enforced by supranational courts, exit clauses may not be fully binding. In particular, the members may decide to renegotiate, or a member wishing to exit may do so unilaterally. By *secession war*, we denote any unilateral exit which does not respect a pre-agreed exit clause or has not been negotiated. We model a secession war as a pair of costs (w, d), where w is the cost the exiting member would have to incur to win the secession war (including both the direct costs and the reputational costs) and d is the corresponding damage to the remaining member.

The direct costs of a secession war hinge on the relative ease of exerting military force over a federal entity's territory. The stronger the presence of a loyal federal army within a federal entity, the more costly a secession war for that entity. Geography also plays a role: overseas regions or regions on the outer border of a federation incur less costs in seceding unilaterally than regions which are geographically contained within a federation. The reputational costs of a secession war depend both on the international norm against unilateral exit and on the circumstances. For instance, regions with oppressed ethnic minorities generally incur low reputational costs, as they tend to be quickly welcomed by the international community, i.e. recognized by other countries, the UN and the WTO (Buchanan 1997; Sorens 2016). For an analysis of third countries' recognition strategies, see Coggins (2011).

Arguably, if a member of the federation has the choice between using an exit clause and engaging in a secession war, it will pick the option with the lowest cost. Hence exit clauses with costs $c + k$ above w are ineffective as they cannot be enforced: the exit clause will never be used, but a secession war will occur if the state drops below $x^e(w) = -\theta - rw + \frac{1}{\beta}$ and a negotiated exit is not forthcoming. The higher the cost w, the less relevant the secession war option and hence the less severe the enforcement problem.

The uncertainty of exit costs

The model assumes that both the costs of exit per an exit clause, $c + k$, and the cost of a secession war w are certain. This assumption is not restrictive under two conditions: (1) the members of the federation are risk-neutral, and (2) no new information about these costs is released over time. If the members are not risk-neutral, the possible variance of the exit costs matters on top of their expected value. If new information about the exit costs becomes available over time[7], the real options model would be complicated significantly but presumably the result would be that the optimal forbearance increases. If information is released over time it may become worthwhile, ceteris paribus, to postpone the exit decision a little longer to base the decision on a more precise estimate of the exit costs.

The consequences of exit for the rest of the union

Until now, we have only considered the member with exit option and dropped the index i, temporarily reducing our two-player model to a one-player model. We now reintroduce the index i for the member with the exit option, and introduce the index j for the member subject to potential exit by member i. For j, the value $V_j(x_i, x_j)$ of being in the union depends on both x_i and x_j: j's benefit flow depends only on x_j, but will be stopped by i depending on x_i.

In the Appendix, we show that if only i has an exit option, j's value of being in the union is

$$V_j(x_i, x_j) = \frac{x_j + \theta_j}{r} + \left(c_i - k_j - \frac{x_j + \theta_j}{r}\right) e^{\beta_i (x_i - x_i^e)} \tag{10}$$

[7] For instance by observing cases of other federal entities seceding unilaterally, as suggested by Walter (2006).

The first term again reflects the expected perpetuity value from the union, and is higher the higher j's state x_j and type θ_j. The second term reflects the option value from i's potential exit. This option value can be positive or negative; it is higher the higher the penalty c_i that j would receive, the lower j's one-off costs k_j, and the lower j's benefit flow $x_j + \theta_j$ that would be lost upon i's exit. As i's state deteriorates to its optimal exit state, j's value function V_j converges to the penalty it receives upon exit minus the one-off costs associated with exit: $\lim_{x_i \to x_i^e} V_j(x_i, x_j) = c_i - k_j$.

Given the initial state of the world $x_i = x_j = 0$, the ex-ante expected value for j is $V_j(0,0) = \frac{\theta_j}{r} + \left(c_i - k_j - \frac{\theta_j}{r}\right) e^{-\beta_i x_i^e}$. The first order condition corresponding to the optimal exit penalty from j's perspective is $\left(1 + r\beta_i \left(c_i - k_j - \frac{\theta_j}{r}\right)\right) e^{-\beta_i x_i^e} = 0$. It is easy to verify that this penalty is $c_i = \frac{\theta_j}{r} + k_j - \frac{1}{r\beta_i}$ and that it indeed corresponds to a maximum. This is the exit penalty preferred by j for the other member i. If only i has an exit option, then j would prefer for i's exit penalty to be higher the higher j's expected benefits, i.e. the higher j's type θ_j. Similarly, the higher j's one-off costs, the higher j would like i's exit penalty to be.

The possibility of an anti-secession war

We have argued that federal unions may not be fully binding because of the possibility of a secession war and of a negotiated exit. A further enforcement problem is the possibility of an anti-secession war. Even if the union includes an exit clause, a member trying to make legal use of this clause may be faced with an anti-secession war by the remaining member. Something to this effect occurred during the break-up of the Soviet Union, which tried preventing the secession of some Soviet republics. In the case of the American Civil War, some Southerners claimed there was an implicit secession right and that hence the North was conducting an illegal anti-secession war (Buchanan, 1997: 36).

Conducting an anti-secession war is an option for j if i has exercised its exit option. Intuitively, this option is more attractive for j the worse off it would be by accepting i's legal exit. From (10), accepting i's exit is worse for j the lower the penalty c_i it would receive, the higher one-off costs k_j, and the higher the lost benefit flow $x_j + \theta_j$. While we omit a formal derivation it is clear that an attempt to prevent a legal exit militarily becomes more attractive for j the lower the exit penalty c_i it would receive. Thus the possibility of an anti-secession war poses a lower limit on enforceable exit costs: if c_i is too low, legal exit attempts by i might be met by an anti-secession war conducted by j.

The stronger the international norm against preventing legal secession, the higher the reputational cost of trying to prevent it and hence the less relevant the anti-secession war option as an enforcement problem. Because democracies tend to be more sensitive to reputational costs, anti-secession wars may be only relevant in autocracies such as the Soviet Union. On this point, see the plenary debate on 25 April 2003 on the introduction of the EU's withdrawal clause (now known as Article 50 of the Treaty on European Union). During the plenary, Mr. Roche from the Irish Government said "… it is worthwhile reminding the Convention that the former Soviets did have an exit clause, but if you chose to exercise it they would send gentlemen in tanks to talk to you".

Socially efficient exit

In this section we study exit from the point of the entire union. In a union with two members, exit by one member leads to the end of the union. By deriving the impact of exit on the combined benefits of the two players x_C, we derive a condition for socially efficient exit. Taking the benefits of both members into account, this condition stipulates in which states of the world (x_i, x_j) the union should be preserved, and in which states it should be terminated. To ease the exposition, we present the derivation of the socially efficient exit state as stemming from a social planner who has as an objective function the sum of the members' benefits.

We start by showing that if the benefit flows of both members are Brownian motions, then their combined benefit flow is also a Brownian motion. Recalling that the increments ϵ_{At} and ϵ_{Bt} of the Brownian motions $x_A(t)$ and $x_B(t)$ are jointly normally distributed for all t, the combined benefit flow π_C can be written as

$$\pi_C(t) = \pi_A(t) + \pi_B(t) = x_C(t) + \theta_C \tag{11}$$

where the combined state $x_C(t) = x_A(t) + x_B(t)$ and the combined type $\theta_C = \theta_A + \theta_B$. Using the definition of x_C, the increments $dx_C = \sigma_A\epsilon_{At}\sqrt{dt} + \sigma_B\epsilon_{Bt}\sqrt{dt}$ are normally distributed with variance $\sigma_C^2 = \sigma_A^2 + \sigma_B^2 + 2\rho\sigma_A\sigma_B$. The variance of the combined state is determined by the variances of the states of the members, and by their correlation ρ.

The social planner's continuation value is defined in terms of the Brownian motion $x_C(t)$. We show in the Appendix that the condition for socially efficient exit can be expressed in terms of x_A and x_B:

$$x_C = x_C^e \Leftrightarrow x_A + x_B = -(\theta_A + \theta_B) - rk_C + \frac{1}{\beta_C} \tag{12}$$

Socially efficient exit requires taking into account the states of both members, as well as the total one-off costs of separation of $k_C = k_i + k_j$ and the optimal forbearance level $1/\beta_C$. If the combined state $x_A + x_B$ drops below the threshold specified in (12), terminating the union is socially efficient. Consistent with the notion of efficient breach presented in the introduction, socially efficient exit may require hurting one member if this benefits the other member more. If one member, say A, is in a good state (a high x_A), while B is in a bad state (a low x_B), the socially efficient exit decision is taken by adding up both states and comparing the result with the total one-off costs of the separation $k_A + k_B$.

Substantively, the condition of a low joint state x_C required for socially efficient exit can be fulfilled if heterogeneity has increased, or if the outside options of both players have improved simultaneously through an increase in free trade or peace. Elements that hurt one member while benefitting another, such as fiscal transfers, do not matter from this perspective. Similarly, from the social planner's point of view, exit penalties are internal transfers and do not matter. However, as we have shown in (23) and (28) for the individual members exit penalties do matter. The higher the exit penalty c_i, the lower the state x_i^e at which member i exits. In the next section, we show that the exit penalty c_i can be defined so as to induce i to make socially efficient exit decisions.

State-contingent exit penalties

In the Appendix, we derive i's optimal exit behavior if the exit penalty can be made state-contingent. We show that if the penalty is of the form $c_i(x_j) = ax_j + b$, then i exits in states (x_i^e, x_j^e) satisfying

$$x_i^e + arx_j^e = -\theta_i - r(b + k_i) + \frac{1}{\lambda_i}, \qquad \lambda_i = -\sqrt{\frac{2r}{\sigma_i^2 + a^2r^2\sigma_j^2 + 2ar\rho\sigma_i\sigma_j}} \tag{13}$$

For this condition to lead to socially efficient exit as in (12), one finds $a = \frac{1}{r}$, so that $\lambda_i = \beta_i$ and $b = \frac{\theta_j}{r} + k_j$. Hence the socially efficient exit penalty for i is

$$c_i^* = \frac{x_j + \theta_j}{r} + k_j \tag{14}$$

The higher the state of the other member x_j, the higher i's exit cost should be to induce it to take socially efficient exit decisions. This is intuitive: the more member j is enjoying the union, the higher should be i's penalty for ending the union. Conversely, if member j is in a very bad state, member i would receive a positive payment for ending the union. The second term of c_i^*, equal to k_j, reflects that for socially efficient exit i needs to be incentivized to take j's one-off costs of i's exit into account.

Under the socially efficient exit penalty c_i^*, i's option value coincides with the social planner's option value:

$$c_i = c_i^* \Rightarrow V_i(x_i, x_j) = \frac{x_i + \theta_i}{r} - \frac{e^{\beta_C (x_C - x_C^e)}}{r\beta}, \qquad V_j(x_i, x_j) = \frac{x_j + \theta_j}{r} \tag{15}$$

This is because i has the same costs and benefits from stopping the union as the social planner: the payment of $k_i + k_j$, and the loss of the perpetuity value $\frac{x_i + x_i}{r}$. The loss of x_i/r is direct: by stopping the union, i stops its benefit flow. The loss of x_j/r is indirect: the socially efficient exit penalty requires that i pay x_j/r to j.

Optimal exit in a game-theoretical setting

In the previous section, we formally analyzed the case where only one member had an exit option. In this section, we discuss exit in a game-theoretical setting. If both members have an exit option, member i's optimal exit strategy will depend on member j's exit strategy and vice versa. In such a setting, no analytical solutions are available because the exit options are no longer perpetual: member i's (stochastic) exit time is the expiration date of member j's exit option. In addition, the analysis in this setting depends crucially on the possibility of a negotiated exit, which is hard to formalize appropriately.

If there are no obstacles to negotiating exit, socially efficient exit occurs irrespective of a potential exit clause. Although in this case the conditions of the exit clause do not matter for the timing of exit, the exit costs stipulated in the exit clause may affect the side-payments made to forestall or obtain exit, similar to the distribution of property rights in Coase (1960).

In reality many obstacles may limit the scope for negotiating exit. Politicians or voters may be loss-averse or boundedly rational. Moreover, transfers may be costly or members' states may be privately observed (Fearon 1995). The importance of such impediments to a negotiated exit is ultimately an empirical matter. But because these impediments are hard to measure, we prefer not to formally model the role of negotiated exit and provide a discussion instead.

If negotiating exit is not frictionless, the possibility of an inefficient secession war reemerges, and with it the scope for exit clauses to improve social welfare. In particular, setting the exit cost $c_i + k_i$ equal to the cost of a secession war w_i would be welfare enhancing: when i's state drops to $x_i^e(w_i)$, it will pay the penalty $c_i = w_i - k_i$ to j, instead of starting a secession war which costs d_j to j. If the state of the world is fully contractible, efficiency could be further increased in the absence of renegotiation by making member i's exit cost conditional on j's state as in (15). However, since the lack of observability of j's state by i may precisely be one of the impediments to a negotiated exit, it seems optimistic to assume that state-contingent exit clauses could fully restore social efficiency.

To conclude this section we summarize the predictions of our theory based on the decision theoretical model and our discussion of negotiated exit. We identified three potential modes of exit: ex-post negotiation, unilateral exit, and exit based on an ex-ante agreed exit clause. If both members of a union are benefitting from it (are in a good state), neither will consider exit. Hence in states of the world (x_i, x_j) where both x_i and x_j are high the union continues. If both i and j are in a bad state, i.e. x_i and x_j are both low, exit will be negotiated and the union is dissolved.

If i is in a bad state (low x_i) while j is in a good state (high x_j), i's decision whether to exit depends on the exit costs of its cheapest mode of exit. If there is an exit clause, the associated exit costs consist of the penalty c_i and the one-off costs k_i. The costs of unilateral exit (secession war) are w. The higher i's exit costs and the lower the variance σ_i, the lower the state x_i can drop until exit becomes optimal for i. If there are no barriers to ex-post negotiation, exit occurs when it is socially efficient, i.e. when the combined benefits of both members drop below a critical level. The side-payment made for such a negotiated exit depends on i's exit costs, and on j's costs of an anti-secession war. If i faces low exit costs and j high anti-secession costs, j makes a side-payment to i for staying in the union. If a negotiated exit is not possible because dissolving the union would not be efficient (i.e. j is benefitting more from the union than i is losing), or because of barriers to negotiation, then i considers unilateral exit.

Empirical evidence

In this section we derive testable hypotheses from our analysis. We focus on hypotheses that have to our knowledge not been tested yet in the literature. The lack of previous testing for these hypotheses is likely due to difficulties with gathering the necessary data. We provide a first stab by analyzing the breakup of Yugoslavia. Since the number of federations with exit clauses is very small, we are also able to test our hypotheses related to exit clauses for all cases known to us of federal exit clauses. While the evidence is supportive of the predictions of our model, it is by nature inconclusive in any statistical sense due to the small number of cases.

Testable hypotheses

The theory presented in this article centers on four key concepts: (1) the net benefits of being in the union versus outside, (2) the costs of unilateral secession through a secession war, (3) the presence of an exit clause and the associated exit costs, and (4) the costs of an anti-secession war. In particular, the theory predicts that exit will occur if a member's net benefits drops below a critical value defined by the exit costs of the cheapest available mode of exit, whether it be a negotiated exit, exit based on an exit clause, or a secession war. Each of the four key concepts is defined by several components.

First, the net benefits of being in the union depend on economies of scale, fiscal transfers, and welfare losses from centralized decision-making in the presence of heterogeneity. Many hypotheses related to these components have been tested elsewhere. Desmet et al. (2011) find support for the importance of economies of scale as proxied by population, for transfers as proxied by GDP per capita, and for cultural heterogeneity as proxied by genetic distances. However, to the best of our knowledge the direct effect of transfers has not been tested so far. Since economic development may have other effects beyond causing fiscal transfers, the following hypothesis is still open for testing:

H1: Federal entities paying fiscal transfers to the rest of the federation are more likely to secede.

Because the benefits of the federation are defined versus the outside option, changes in the outside options also influence the net benefits. Since international organizations can provide economies of scale in defense or market size, this leads us to the following hypothesis:

H2: The outside availability of membership of international organizations increases the likelihood of secession.

Second, predictions of the model depend on the costs of unilateral secession through a secession war. We argued that a secession war has direct costs and reputation costs. The direct costs of a secession war hinge on the relative ease of exerting military force over a federal entity's territory, as determined by relative military capacity and geography. The role of geographical isolation in promoting unilateral secession has been confirmed in the literature (Sorens 2012). The reputational costs of a secession war depend on the stance of the international community, leading to the following hypothesis:

H3: Positive (negative) declarations by third countries regarding recognition increase (decrease) the likelihood of unilateral secession.

Third, and this is our main contribution, our model takes into account the possibility of exit clauses. The costs of exit based on an exit clause are assumed to consist of one-off costs and exit penalties. Because there are no cases on record of federations with exit penalties, hypotheses related to the costs of using an exit clause can only be tested after developing an adequate measure of one-off costs. A more general prediction related to exit clauses that can be tested directly is:

H4: Exit clauses can enable peaceful secession even if there are barriers to ex-post renegotiation.

Finally, we concluded that in response to the triggering of an exit clause, the rump of the federation may start an anti-secession war. However, since trying to prevent an exit clause-based secession carries reputational costs, we argued that anti-secession wars may only be relevant in autocracies, leading to the following testable hypothesis:

H5: Democracies never meet an exit clause-based secession with an anti-secession war.

The breakup of Yugoslavia

After World War II, Josip Broz Tito united Yugoslavia as a Socialist Federal Republic consisting of six republics: Slovenia, Croatia, Bosnia-Herzegovina, Serbia, Montenegro, and Macedonia (Lampe, 2000: 233-235). In 1974, a confederal constitution was adopted (Fine, 2003: 182). While the preamble of this constitution made a reference to a national right to self-determination, Article 5 stated that border changes required the consent of all republics and provinces (Iglar, 1992: 219). The 1974 constitution hence did not have an exit clause in any real sense.

In 1980 the Yugoslav President Tito died. In November 1989 the Berlin Wall fell and over the period 1990-1991 the Soviet Union disintegrated. In June 1991 Slovenia and Croatia unilaterally declared their independence from Yugoslavia, and by the end of the year Macedonia did the same (Hupchick & Cox, 2001: 49). Serbia, controlled by Milošević and considered the dominant republic in the Yugoslav federation, was opposed. In Slovenia, fighting only lasted ten days and its independence was quickly recognized. In Croatia, more fighting took place before its independence was conceded. There was no resistance against Macedonia's independence. In Bosnia-Herzegovina, a three-way war erupted between Bosniaks, Croats and Serbs. Bosnia-Herzegovina declared its independence in March 1992.

The two remaining republics in rump Yugoslavia, Montenegro and Serbia, proclaimed the Federal Republic of Yugoslavia in April 1992. In 1995 the Dayton agreement was signed to restore peace in Bosnia-Herzegovina, and in 1996 the Federal Republic of Yugoslavia recognized Bosnia-Herzegovina. In 2003, the Federal Republic of Yugoslavia renamed itself the State Union of Serbia and Montenegro. Article 60 of the new constitution stipulated that either state could declare its independence after a three year waiting period. In 2006, Montenegro declared its independence after the referendum of 21 May 2006 showed 55.5% of the voters to be in favor. Montenegro was admitted to the UN in June 2006 as its 192th member state.

In February 2008, the Serbian autonomous region of Kosovo proclaimed its independence. In an advisory opinion, the International Court of Justice found that Kosovo's declaration of independence did not violate international law (ICJ 2010). Serbia has not officially recognized Kosovo, but in 2013 the prime ministers of Serbia and Kosovo accepted to normalize relations in the so-called Brussels Agreement mediated by the EU's High Representative Catherine Ashton.

Based on the breakup of Yugoslavia, H1 clearly still stands. Croatia and Slovenia, the first republics to declare independence, were not only economically more advanced, but they were indeed paying transfers to the rest of Yugoslavia (Fine, 2003: 182). One key mechanism for such transfers was the Yugoslav Federal Fund, which provided investment capital for the less developed regions (Bookman, 1993: 97). Hence in terms of fiscal transfers Croatia and Slovenia were on the losing side of the federation. Once the rich republics Croatia and Slovenia had seceded, the transfers they provided stopped. This may explain why it then became beneficial for the poorer regions of Macedonia and Bosnia-Herzegovina to secede as well.

The facts of the Yugoslavian breakup are also consistent with H2. With the adoption of the Single European Act in 1986, the European single market became a tempting outside option for the more developed republics Croatia and Slovenia; Slovenia joined the EU in 2004 and Croatia in 2013. A similar observation holds for the North Atlantic Treaty Organization (NATO). During the Cold War, Yugoslavia had a policy of non-alignment, while outside of Yugoslavia, independent republics were free to seek membership of NATO. Slovenia joined NATO in 2004 and Croatia in 2009.

Regarding the costs of a secession war, H3 is also corroborated by the Yugoslav case. Germany clearly played a role in lowering the reputation costs of unilateral secession by promising to recognize the independence of Croatia and Slovenia (Dragovic-Soso, 2008: 23). Conversely, US policy played a role in increasing the reputational cost of the Kosovo secession. Indeed, in spite of condemning Serb violence, the US for a long time "insisted that Kosovo should remain within Serbia" (Fine, 2003: 187).

Regarding H4, there was no exit clause available to Slovenia, Croatia, Bosnia-Herzegovina, Macedonia or Kosovo so they all seceded unilaterally – resulting in violence in Slovenia, Croatia, Bosnia-Herzegovina and Kosovo. By contrast, in 2006 Montenegro used the exit clause that was entered in the constitution of the State Union of Serbia and Montenegro in 2003. Montenegro respected the waiting period of three years and Serbia accepted the independence peacefully. The fact that the exit clause was called just shortly after the stipulated three-year waiting period is suggestive that exit clauses really can have a binding role in enabling peaceful secession, and corroborates H4. The fact that Serbia peacefully accepted Montenegro's exit clause-based secession also corroborates H5.

The evidence on exit clauses

As indicated in the introduction very few federations have exit clauses. We provide an overview of all cases known to us in Table 1.

Table 1. Overview of federations with exit clauses.

	No exit so far	**Peaceful exit**	**Anti-secession war**
Democracies	European Union Saint Kitts & Nevis	Montenegro	/
Autocracies	Ethiopia	South Sudan	Soviet Union

In the European Union and Saint Kitts & Nevis no exit has occurred so far.[8] Although the UK has started the process of leaving the EU, none of the other member states has suggested meeting the UK's potential exit with military force, corroborating H5. In Ethiopia, the 1991 constitution permitting secession was adopted after the collapse of military rule and the start of Eritrea's independence process. However, scholars are pessimistic about the secession clause, corroborating H5: "The provisions of a liberal democratic constitution conflict with the reality of authoritarian centralist practice and therefore jeopardize the future of federalism. Although the secession clause

[8] On June 23, 2016 the United Kingdom (UK) organized a non-binding referendum on EU membership. The majority voted to leave, and the UK government triggered Article 50 on March 29, 2017.

has symbolic value, it is unlikely that any Ethiopian government would allow secession to take place" (Habtu, 2005: 313).

As discussed, Montenegro's peaceful exit clause-based secession corroborates H4. Another confirmatory case is the 2011 independence of South Sudan from Sudan after the 2005 peace agreement. The 2005 Comprehensive Peace Agreement ended the Second Sudanese Civil War which ran from 1983 to 2005 between the Sudanese government and the Sudan People's Liberation Army located in the South of the country. The peace treaty stipulated that the South would have autonomy for 6 years, and that oil revenues would be split equally during this period. The period of autonomy would be followed by an independence referendum in 2011. In the referendum, 98.8% voted in favor of independence, and South Sudan declared its independence.

Importantly, H4 does not imply that exit clauses are necessary for peaceful secession, since in the absence of barriers to renegotiation secession can be negotiated. Examples that come to mind of such peacefully negotiated secessions are the "velvet divorce" of Czechoslovakia (1993), and the independence of Norway from Sweden (1905).

Considering Table 1, H5 states that the top right cell should be empty. For the limited number of federations with exit clauses, this hypothesis stands: democracies have never met an exit clause-based secession with an anti-secession war. Conversely, the case of the Soviet Union's dissolution makes clear that in autocracies secession may be violent even with exit clauses.

Conclusion

We presented a political economic analysis of secession and exit clauses in federations. In our model, a member's benefits from a political union are determined by its type and its state. Because of changes in the state of the world, a member's benefits may go up or down. Mathematically, we assumed that the state of each member follows a Brownian motion. If a member's benefits become negative, i.e. it is in a low state, it may wish to exit. Using real options theory, we derived a member's optimal exit state. Three factors determine the optimal exit state. The higher a member's type, the higher exit costs, and the higher the variance of benefits, the lower the state can drop until it becomes optimal to exit.

Exit costs depend on the mode of exit. If a federation has an exit clause, exit can occur on the basis of such a clause. Exit clauses can contain several conditions, among which we focused on exit penalties. If the costs of exit according to the exit clause are low, and it occurs while other members are benefitting a lot from the union, those other members may try to prevent exit forcefully through an anti-secession war – as happened in the Soviet Union. However, such attempted prevention of legal exit carries heavy reputational costs, especially for democracies. If there is no exit clause, or the exit cost is high, exit may occur unilaterally. The costs of such unilateral exit consist of tangible costs (such as military expenses) and reputational costs (which depend on the international recognition of the exit). A third mode of exit is through ex-post negotiation, although this can be expected to be difficult because of frictions to negotiations.

When a member exits, the benefits for the other members of that member being in the union are also stopped. From a social efficiency perspective, exit should occur if and only if it generates value taking all members' benefits into account: this is the principle of efficient breach in contract law. Based on a real options model, we showed that appropriate state-contingent exit penalties can ex-ante enable efficient breach if there are barriers to renegotiation. If exit penalties cannot be made state-contingent, fixed exit penalties can still increase social welfare by avoiding secession wars. These findings run counter to the dominant point of view in the constitutionalist literature that exit clauses should be avoided in federations.

By analyzing the breakup of Yugoslavia and all known cases of federations with exit clauses, we found support for five hypotheses derived from our model that have not been directly tested in the literature. First, federal entities paying fiscal transfers to the rest of the federation are more likely to secede. Second, the outside availability of membership of international organizations increases the likelihood of secession. Third, positive declarations by third countries regarding recognition increase the likelihood of unilateral secession. Fourth, exit clauses can enable peaceful secession even if there are barriers to ex-post renegotiation. Fifth, democracies never meet an exit clause-based secession with an anti-secession war. While the evidence is supportive of the predictions of our model, it is by nature inconclusive in any statistical sense due to the small number of cases, and future empirical research is needed.

Our results beg the question why exit clauses are not more prevalent in real-world federations. We tentatively advance three reasons. First, politicians negotiating federations may wish to tie their successors' hands. In our model, we assumed that each member of the political union could be represented as a unitary actor. In practice, political unions may have heterogeneous effects on different parts of the population within one member. If that is the case, politicians whose electorate favors the union may want to prevent exit in the future by not having an exit clause.

Second, political unions may not be rationally designed. This may be especially true for long-established federal countries. But even for modern federations there may be a norm against exit clauses because these are perceived as going against the spirit of collaboration embedded in such unions. Such a norm may also explain why most real-world examples of exit clauses (such as the EU's Article 50) have no exit penalties, in spite of the theoretical importance of exit costs to achieve socially efficient exit decisions.

Third, exit clauses may not be prevalent in the real world because powerful members of the federation may be able to impose their terms. Given favorable substantive terms of the union, they would expect to benefit a lot from being in it. In turn, this would lead them to prefer a high exit cost for the other members. Expecting to be able to easily negotiate exit if the union would ever stop being beneficial to them, they may prefer not having an exit clause altogether and successfully impose this.

We leave for future research the negotiation of exit clauses. Given the distributional implications of exit clauses, the bargaining process will be important and socially efficient exit clauses are not guaranteed. However, to the extent that members are negotiating behind a veil of ignorance, their ex-ante preferences will be closer to the social optimum and negotiations will be easier. A second area for future research is to make the link between the state of the world and payoffs endogenous. In the model presented here, the payoff-relevant state of the world is exogenous. In practice members may be able to change how the state of the world affects their payoffs by renegotiating the terms of the union. For instance, federal laws affect how the state of the world maps to federal transfers and hence to the benefits from the union. If at some point the prevailing transfers make the federation undesirable to a member, this member will likely try to renegotiate the federal laws before considering exit.

References

Alesina, Alberto, and Enrico Spolaore. 2003. *The Size of Nations*. Cambridge, Mass: MIT Press.

Athanassiou, Phoebus. 2009. "Withdrawal and Expulsion from the EU and EMU: Some Reflections." *ECB Legal Working Paper Series* (10).

Bookman, Milica Zarkovic. 1993. *The Economics of Secession*. New York: St. Martin's Press.

Bordignon, Massimo, and Sandro Brusco. 2001. "Optimal Secession Rules." *European Economic Review* 45(10): 1811–34.

Buchanan, Allen. 1997. "Theories of Secession." *Philosophy & Public Affairs* 26(1): 31–61.

Chen, Yan, and Peter C. Ordeshook. 1994. "Constitutional Secession Clauses." *Constitutional Political Economy* 5(1): 45–60.

Coase, Ronald. 1960. “The Problem of Social Cost.” *Journal of Law and Economics* 3: 1–47.

Coggins, Bridget. 2011. “Friends in High Places: International Politics and the Emergence of States from Secessionism.” *International Organization* 65(3): 433–67.

Desmet, Klaus, Michel Le Breton, Ignacio Ortuño-Ortin, and Shlomo Weber. 2011. “The Stability and Breakup of Nations: A Quantitative Analysis.” *Journal of Economic Growth* 16: 183–213.

Dixit, Avinash K. 1989. “Entry and Exit Decisions under Uncertainty.” *Journal of Political Economy* 97(3): 620.

Dixit, Avinash K., and Robert S. Pindyck. 1994. *Investment under Uncertainty*. Princeton, N.J: Princeton University Press.

Dragovic-Soso, Jasna. 2008. “Why Did Yugoslavia Disintegrate? An Overview of Contending Explanations.” In *State Collapse in South-Eastern Europe: New Perspectives on Yugoslavia’s Disintegration*, eds. Lenard J. Cohen and Jasna Dragovic-Soso. West Lafayette, Indiana: Purdue University Press, 1–39.

Drèze, Jacques, Paul De Grauwe, and Jeremy Edwards. 1993. “Regions of Europe: A Feasible Status, to Be Discussed.” *Economic Policy* 8(17): 265–307.

Fearon, James D. 1995. “Rationalist Explanations for War.” *International Organization* 49(3): 379–414.

Filippov, Mikhail, Peter C. Ordeshook, and Olga Shvetsova. 2004. *Designing Federalism: A Theory of Self-Sustainable Federal Institutions*. Cambridge University Press.

Fine, John. 2003. “Heretical Thoughts about the Postcommunist Transition in Once and Future Yugoslavia.” In *Yugoslavia and Its Historians: Understanding the Balkan Wars of the 1990s*, eds. Norman Naimark and Holly Case. Stanford University Press, 179–92.

Goetz, Charles J., and Robert E. Scott. 1977. “Liquidated Damages, Penalties and the Just

Compensation Principle: Some Notes on an Enforcement Model and a Theory of Efficient Breach." *Columbia Law Review* 77(4): 554–94.

Griffiths, Ryan D. 2015. "Between Dissolution and Blood: How Administrative Lines and Categories Shape Secessionist Outcomes." *International Organization* 69(3): 731–51.

Habtu, A. 2005. "Multiethnic Federalism in Ethiopia: A Study of the Secession Clause in the Constitution." *Publius: The Journal of Federalism* 35(2): 313–35.

Helfer, Laurence R. 2005. "Exiting Treaties." *Virginia Law Review* 91(7): 1579–1648.

Hug, Simon. 2005. "Federal Stability in Unequal Societies." *Constitutional Political Economy* 16(2): 113–24.

Hupchick, Dennis P., and Harold E. Cox. 2001. *Palgrave Concise Historical Atlas of the Balkans*. New York, NY: Palgrave.

ICJ. 2010. "Accordance with International Law of the Unilateral Declaration of Independence in Respect of Kosovo." *Advisory Opinion, International Court of Justice Reports 2010*: 403–53.

Iglar, Richard F. 1992. "The Constitutional Crisis in Yugoslavia and the International Law of Self-Determination: Slovenia's and Croatia's Right to Secede." *Boston College International and Comparative Law Review* 15(1): 213–39.

Kogut, Bruce. 1991. "Joint Ventures and the Option to Expand and Acquire." *Management Science* 37(1): 19–33.

Koremenos, Barbara. 2005. "Contracting Around International Uncertainty." *American Political Science Review* 99(4): 549–65.

Koremenos, Barbara, and Allison Nau. 2010. "Exit, No Exit." *Duke Journal of Comparative & International Law* 21: 81–119.

Lampe, John R. 2000. *Yugoslavia as History: Twice There Was a Country*. 2nd ed. Cambridge, UK: Cambridge University Press.

Mörters, Peter, and Yuval Peres. 2010. *Brownian Motion*. Cambridge University Press.

Øksendal, Bernt. 1991. *Stochastic Differential Equations*. New York: Springer.

Rosendorff, B. Peter, and Helen V. Milner. 2001. "The Optimal Design of International Trade Institutions: Uncertainty and Escape." *International Organization* 55(4): 829–57.

Sorens, Jason. 2012. *Secessionism: Identity, Interest, and Strategy*. Montreal: McGill-Queen's University Press.

———. 2016. "Hearing: U.S. Policy Toward National Self-Determination Movements." *House Committee on Foreign Affairs* March 15: 1–6.

Stokey, Nancy L. 2008. *The Economics of Inaction: Stochastic Control Models with Fixed Costs*. Princeton: Princeton University Press.

Sunstein, Cass R. 1991. "Constitutionalism and Secession." *The University of Chicago Law Review* 58(2): 633–70.

Tir, Jaroslav, Philip Schafer, Paul Diehl, and Gary Goertz. 1998. "Territorial Changes, 1816-1996: Procedures and Data." *Conflict Management and Peace Science* 16(1): 89–97.

Walter, Barbara F. 2006. "Information, Uncertainty, and the Decision to Secede." *International Organization* 60(1): 105–35.

Weinstock, Daniel. 2001. "Constitutionalizing the Right to Secede." *The Journal of Political Philosophy* 9(2): 182–2003.

Young, Robert. 1994. "How Do Peaceful Secessions Happen ?" *Canadian Journal of Political Science / Revue canadienne de science politique* 27(4): 773–92.

Appendix

Derivation of the continuation value

At any point in time, in order for a member to be willing to maintain the union for dt longer, the expected change in the continuation value combined with the benefit flow (1) over dt should add up to the normal return $rV(x)dt$:

$$E[dV] + (x + \theta)dt = rV(x)dt \tag{16}$$

Determining the continuation value is just like pricing a stock with expected appreciation $E[dV]$ and dividend flow $x + \theta$. By Ito's lemma, $dV = \frac{\partial V}{\partial t}dt + \frac{\partial V}{\partial x}dx + \frac{1}{2}\frac{\partial^2 V}{\partial x^2}(dx)^2$; see Øksendal (1991) for the theory of stochastic differential equations and a discussion of Ito's lemma. The benefit flow does not depend on calendar time directly: $\frac{\partial V}{\partial t} = 0$. Together with (2), $E[dx] = 0$ and $E[(dx_i)^2] = \sigma_i^2 dt$, this implies

$$dV = V'(x)dx + \frac{1}{2}V''(x)\sigma^2\epsilon_t^2 dt \Rightarrow\ E[dV] = \frac{1}{2}V''(x)\sigma^2 dt \tag{17}$$

By substituting (17) in (16), we find

$$\frac{1}{2}\sigma^2 V''(x) - rV(x) = -x - \theta \tag{18}$$

This is a second order differential equation in x: we solve it by first identifying the solution $V_h(x)$ of the homogeneous equation $\frac{1}{2}\sigma^2 V''(x) - rV(x) = 0$. Next we identify a particular solution $V_p(x)$ which satisfies the equation $\frac{1}{2}\sigma^2 V''(x) - rV(x) = -x - \theta$. The general solution is given by the particular solution plus any linear combination of solutions to the homogeneous equation. For the homogeneous part, we try a solution of the form $V(x) = e^{\lambda x}$. This yields

$$V_h(x) = Ae^{\alpha x} + Be^{\beta x}, \qquad \alpha = \sqrt{\frac{2r}{\sigma^2}}, \beta = -\sqrt{\frac{2r}{\sigma^2}} \tag{19}$$

with constants A and B to be identified. Note that $\alpha > 0$ and $\beta = -\alpha < 0$. For a particular solution, we try $V(x) = ax + b$. This yields the solution $V_p(x) = \frac{x+\theta}{r}$. This is the expected perpetuity value from the union starting from state x. Combining the particular solution with the homogeneous part, the general solution is

$$V(x) = V_p(x) + V_h(x) = \frac{x+\theta}{r} + Ae^{\alpha x} + Be^{\beta x} \tag{20}$$

Since $V_p(x)$ represents the value from maintaining the union perpetually, $V_h(x)$ represents the option value of exit, which should be positive. As the state improves, the value of the exit option should converge to 0: the better the state, the higher your benefit flow and the less valuable the exit option. This implies that $A = 0$ since $\alpha > 0$. We now have an expression for the continuation value $V(x)$ up to the constant B. This constant will be determined by a boundary condition corresponding to optimal exit.

Optimal exit with a penalty c

Two conditions are needed for optimal exit in a continuous time stochastic model (Dixit and Pindyck 1994). The first is *Value Matching (VM)*: exit should occur when $V(x)$ drops to the value of the outside option. In our model, the outside option consists of paying the one-off costs and the penalty c, which corresponds to a value of $-k - c$. The second condition is *Smooth Pasting (SP)*: optimal stopping requires that $V'(x)$ be equal to the derivative of the value of being outside of the union – which is 0 in our case, since the exit value does not depend on the state. Grouping the two conditions we obtain a system with two equations and two unknowns (x^e, B):

$$V(x^e) = -k - c \Leftrightarrow \frac{x^e + \theta}{r} + Be^{\beta x^e} = -k - c \qquad \textbf{\textit{VM}}\ (21)$$

$$V'(x^e) = 0 \Leftrightarrow \frac{1}{r} + \beta B e^{\beta x^e} = 0 \qquad \textbf{\textit{SP}}\ (22)$$

The solutions for (x^e, B) are

$$x^e = -\theta - r(k + c) + \frac{1}{\beta}, \qquad B = -\frac{e^{-\beta x^e}}{r\beta} \qquad (23)$$

The value function of a member without exit option

Just like (16), over an infinitesimal period dt the expected change in value combined with the benefit flow should add up to the normal return $rV_i\big(x_i, x_j\big)dt$:

$$E\big[dV_j\big] + \big(x_j + \theta_j\big)dt = rV_j\big(x_i, x_j\big)dt \qquad (24)$$

Ito's lemma in two dimensions (Øksendal 1991) gives

$$\begin{aligned} dV_j &= \frac{\partial V_j}{\partial t}dt + \frac{\partial V_j}{\partial x_i}dx_i + \frac{\partial V_j}{\partial x_j}dx_j \\ &+ \frac{1}{2}\left[\frac{\partial^2 V_j}{\partial x_i^2}(dx_i)^2 + \frac{\partial^2 V_j}{\partial x_j^2}\big(dx_j\big)^2 + 2\frac{\partial^2 V_j}{\partial x_i \partial x_j}dx_i dx_j\right] \end{aligned} \qquad (25)$$

Now, since V_j is time-independent and using the properties of the Brownian motions x_A and x_B, $E\big[dV_j\big] = \frac{1}{2}dt\left[\sigma_i^2 \frac{\partial^2 V_j}{\partial x_i^2} + \sigma_j^2 \frac{\partial^2 V_j}{\partial x_j^2} + 2\rho\sigma_i\sigma_j \frac{\partial^2 V_j}{\partial x_i \partial x_j}\right]$. Fill this out in (24) to obtain the partial differential equation

$$\frac{1}{2}\left[\sigma_i^2 \frac{\partial^2 V_j}{\partial x_i^2} + \sigma_j^2 \frac{\partial^2 V_j}{\partial x_j^2} + 2\rho\sigma_i\sigma_j \frac{\partial^2 V_j}{\partial x_i \partial x_j}\right] + x_j + \theta_j = rV_j(x_i, x_j) \qquad (26)$$

If i exits, j receives the exit penalty c and incurs one-off cost k_j. Since i will exit at $x_i^e = -\theta_i - r(k_i + c_i) + \frac{1}{\beta_i}$, the appropriate value-matching condition is

$$\forall x_j\colon\ V_j\left(x_i^e, x_j\right) = c_i - k_j \qquad \textbf{\textit{VM}}\ (27)$$

Since j undergoes i's exit decision, there is no smooth-pasting condition for optimality. The solution for $V_j(x_i, x_j)$ needs to satisfy both the partial differential equation (26) and the value-matching condition VM (27). The general solution of (26) consists of a particular solution and any linear combination of solutions to the homogeneous equation. A particular solution is again $V_{jp}(x_i, x_j) = \frac{x_j+\theta_j}{r}$, the perpetuity value of the union.

If the Brownian motions are uncorrelated and $\rho = 0$, then the partial differential equation is separable and analytical solutions can be obtained for the homogeneous equation as well. As before, one solution for the homogeneous equation is $e^{\beta_i x_i}$ with $\beta_i = -\sqrt{\frac{2r}{\sigma_i^2}}$. Since the particular solution $V_{jp} = \frac{x_j+\theta_j}{r}$ contains x_j but VM (27) does not, we should identify a solution for the homogeneous equation which also contains x_j. One can verify that $x_j e^{\beta_i x_i}$ is such a solution. Combining the particular solution with the two solutions of the homogeneous problem, we get $V_j\left(x_i, x_j\right) = \frac{x_j+\theta_j}{r} + Ce^{\beta_i x_i} + Dx_j e^{\beta_i x_i}$. Using VM (27), $C = \left(c_i - k_j - \frac{\theta_j}{r}\right) e^{-\beta_i x_i^e}$ and $D = -\frac{e^{-\beta_i x_i^e}}{r}$, so that

$$V_j\left(x_i, x_j\right) = \frac{x_j + \theta_j}{r} + \left(c_i - k_j - \frac{x_j + \theta_j}{r}\right)\ e^{\beta_i\left(x_i - x_i^e\right)} \qquad (28)$$

Socially efficient exit

At the time of exit, the members incur the one-off costs k_i and k_j. From the social planner's point of view, any penalty c_i is a pure transfer from i to j and does not play a role when considering the union as a whole. Hence the social value of exit is $-k_C = -(k_i + k_j)$. The value-matching and smooth-pasting conditions are

$$V_C(x_C^e) = -2k \Leftrightarrow \frac{x_C^e + \theta_C}{r} + Be^{\beta_C x_C^e} = -k_C \qquad \textbf{\textit{VM}}\ (29)$$

$$V_C'(x_C^e) = 0 \Leftrightarrow \frac{1}{r} + \beta_C B e^{\beta_C x_C^e} = 0 \qquad \textbf{\textit{SP}}\ (30)$$

Resulting in the socially efficient exit state $x_C^e = -\theta_C - rk_C + \frac{1}{\beta_C}$ with $\beta_C = -\sqrt{\frac{2r}{\sigma_A^2+\sigma_B^2+2\rho\sigma_A\sigma_B}}$.

The condition for socially efficient exit can be expressed in terms of the underlying states x_A and x_B:

$$x_C = x_C^e \Leftrightarrow x_A + x_B = -(\theta_A + \theta_B) - rk_C + \frac{1}{\beta_C} \tag{31}$$

State-contingent exit penalties

If the penalty c_i can be made state-contingent, then i's continuation value will depend on x_j. Assume only i has an exit option but the exit cost c_i is a function of x_j, specifically

$$c_i(x_j) = ax_j + b \tag{32}$$

As in (16), in order for i to stay in the union for dt longer at state (x_i, x_j), the expected change in continuation value combined with the benefit flow should add up to the normal return $rV_i(x_i, x_j)dt$

$$E[dV_i] + (x_i + \theta_i)dt = rV_i(x_i, x_j)dt \tag{33}$$

Ito's lemma in two dimensions gives

$$\begin{aligned} dV_i &= \frac{\partial V_i}{\partial t}dt + \frac{\partial V_i}{\partial x_i}dx_i + \frac{\partial V_i}{\partial x_j}dx_j \\ &+ \frac{1}{2}\left[\frac{\partial^2 V_i}{\partial x_i^2}(dx_i)^2 + \frac{\partial^2 V_i}{\partial x_j^2}(dx_j)^2 + 2\frac{\partial^2 V_i}{\partial x_i \partial x_j}dx_i dx_j\right] \end{aligned} \tag{34}$$

Now, since V_i is time-independent and using the properties of the Brownian motions x_A and x_B, $E[dV] = \frac{1}{2} dt \left[\sigma_i^2 \frac{\partial^2 V_i}{\partial x_i^2} + \sigma_j^2 \frac{\partial^2 V_i}{\partial x_j^2} + 2\rho\sigma_i\sigma_j \frac{\partial^2 V_i}{\partial x_i \partial x_j}\right]$. Fill this out in (33) to obtain the partial differential equation

$$\frac{1}{2}\left[\sigma_i^2 \frac{\partial^2 V_i}{\partial x_i^2} + \sigma_j^2 \frac{\partial^2 V_i}{\partial x_j^2} + 2\rho\sigma_i\sigma_j \frac{\partial^2 V_i}{\partial x_i \partial x_j}\right] + x_i + \theta_i = rV_i(x_i, x_j) \qquad (35)$$

As in the main text, a particular solution is $V_p(x_i, x_j) = \frac{x_i + \theta_i}{r}$, the perpetuity value of the union. For the homogeneous part, which corresponds to the option value of exit, try $V_h(x_i, x_j) = e^{\lambda_i x_i + \lambda_j x_j}$ to obtain

$$\sigma_i^2 \lambda_i^2 + \sigma_j^2 \lambda_j^2 + 2\rho\sigma_i\sigma_j\lambda_i\lambda_j = 2r \qquad (36)$$

This gives $V_i(x_i, x_j) = \frac{x_i + \theta_i}{r} + Ce^{\lambda_i x_i + \lambda_j x_j}$ with C to be determined and λ_i, λ_j satisfying (36).

Since upon exit i has to pay the penalty $c(x_j) = ax_j + b$ and incurs the one-off cost k_i, the value-matching condition at an exit state $x^e = (x_i^e, x_j^e)$ is

$$V(x^e) = -c(x_j^e) - k_i \Leftrightarrow \frac{x_i^e + \theta_i}{r} + Ce^{\lambda_i x_i^e + \lambda_j x_j^e} = -c(x_j^e) - k_i \qquad \boldsymbol{VM}\ (37)$$

There are two smooth-pasting conditions because i should take both x_i and x_j into account when thinking about exit. The penalty does not depend on x_i, but it does depend on x_j, so that

$$\begin{aligned} \frac{\partial V_i}{\partial x_i}(x^e) = 0 &\Leftrightarrow \frac{1}{r} + C\lambda_i e^{\lambda_i x_i^e + \lambda_j x_j^e} = 0 \\ \frac{\partial V_i}{\partial x_j}(x^e) = -\frac{\partial c}{\partial x_j} &\Leftrightarrow C\lambda_j e^{\lambda_i x_i^e + \lambda_j x_j^e} = -a \end{aligned} \qquad \boldsymbol{SP}\ (38)$$

Combining conditions (36), ***VM*** (37) and ***SP*** (38), one finds

$$\lambda_i = -\sqrt{\frac{2r}{\sigma_i^2 + a^2 r^2 \sigma_j^2 + 2ar\rho\sigma_i\sigma_j}}, \qquad \lambda_j = ar\lambda_i \qquad (39)$$

Filling this out, one finds that optimal exit for i is defined in terms of the following linear combination of x_i and x_j

$$x_i^e + arx_j^e = -\theta_i - r(b + k_i) + \frac{1}{\lambda_i} \tag{40}$$

The higher a or the more c_i is made contingent on x_j, the higher the weight of x_j in i's exit decision. Member i's continuation value depends on its own state x_i for the perpetuity value, and on the linear combination of x_i and x_j for the option value

$$V_i(x_i, x_j) = \frac{x_i + \theta_i}{r} - \frac{e^{\lambda_i\left[(x_i+arx_j)-(x_i^e+arx_j^e)\right]}}{r\lambda_i} \tag{41}$$

It is easy to verify that with a non-state contingent exit penalty $c_i(x_j) = c$, i.e. $a = 0, b = c$, the solution reduces to non-state contingent solution presented in the main text.